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Nakano et al.

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(54) **IMAGE FORMING APPARATUS**

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G03G 21/20 (2006.01)
G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/206*** (2013.01); ***G03G 15/2017*** (2013.01)

(58) **Field of Classification Search**
USPC 399/92
See application file for complete search history.

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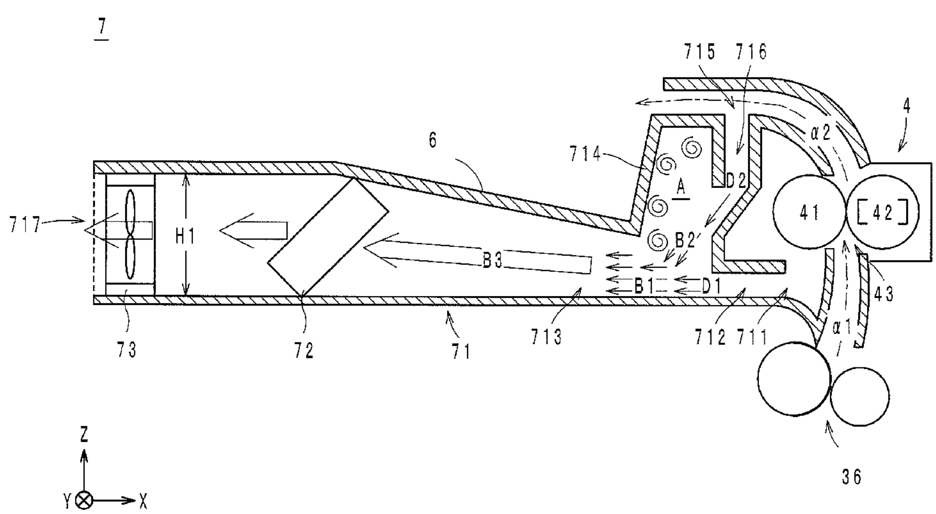
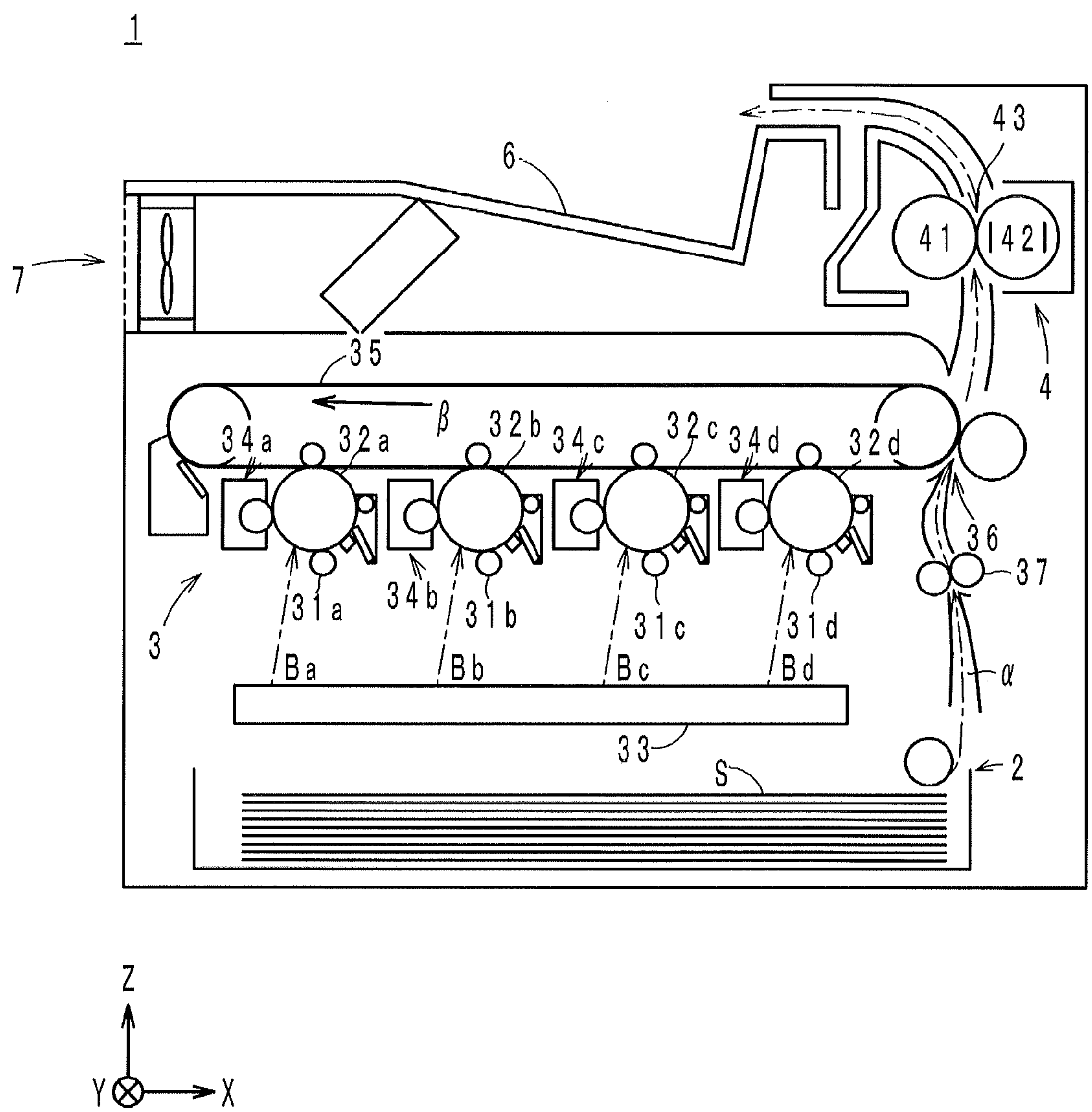
(57) **ABSTRACT**

An image forming apparatus has a fusing unit including a first rotor provided with a heat-generating unit and an elastic layer, as well as a second rotor provided in direct contact with the first rotor, the fusing unit fixing a toner image on a sheet, and a duct for allowing an inlet and an exhaust outlet to communicate with each other, the inlet being adapted to allow a current of air derived from the fusing unit to flow in, the exhaust outlet facing toward the outside of the apparatus. The duct includes an introduction channel for guiding and jetting out air taken in from the inlet, a main channel for guiding the air jetted out of the introduction channel to the exhaust outlet, and a cul-de-sac provided in communication with the main channel at one end and closed at the other end.

7 Claims, 6 Drawing Sheets



F I G . 1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43
6
41
421
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β
32b
34c
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32d
34a
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36
37
34b
31a
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2
Z
Y
X

FIG. 2

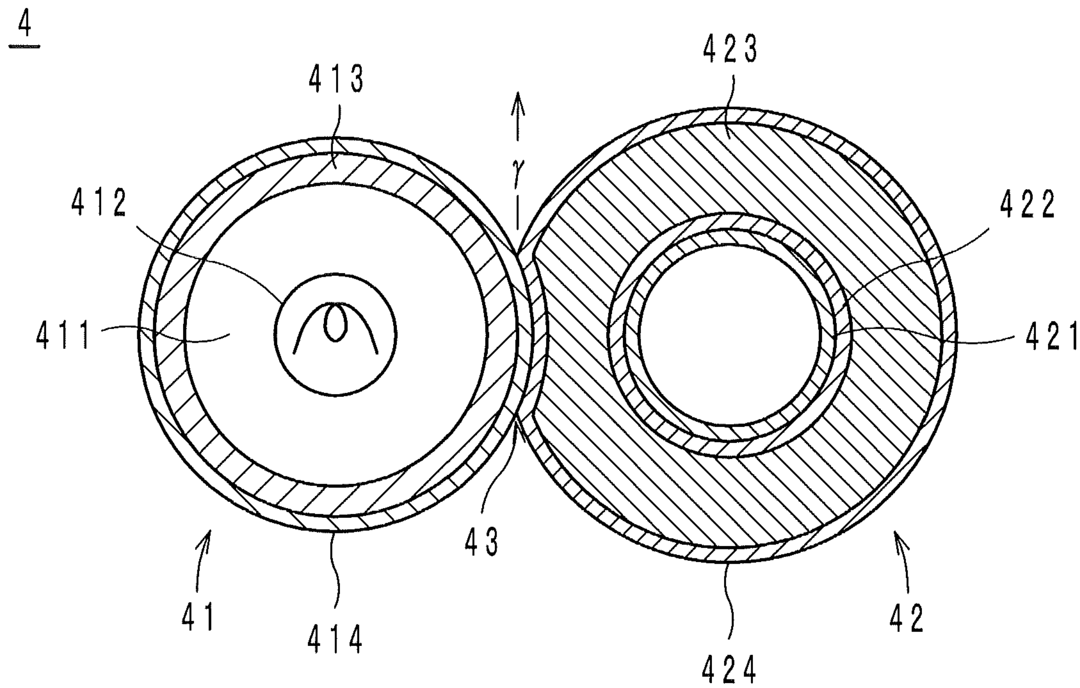
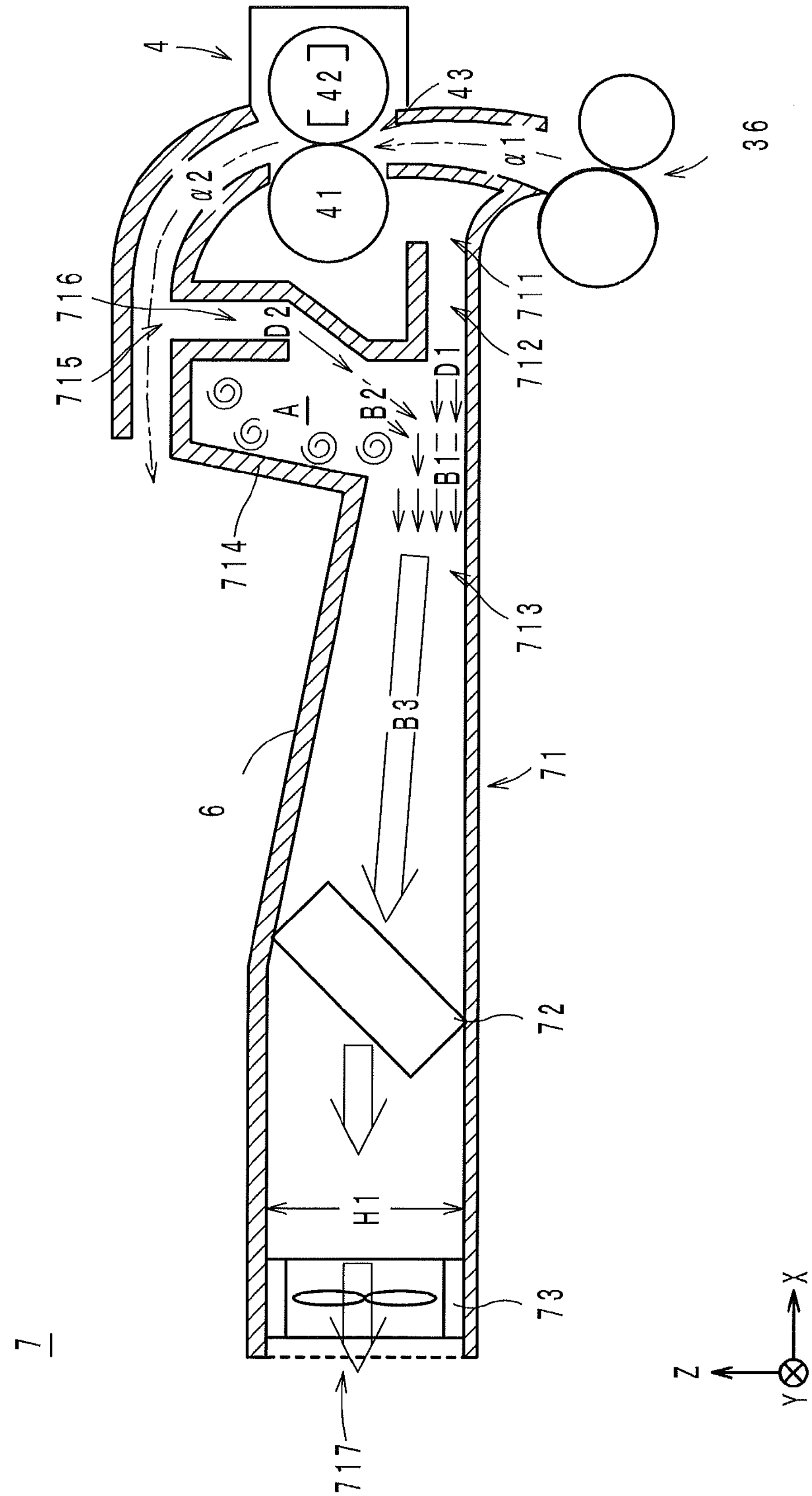


FIG. 3


7
4
42
43
36
41
α1
α2
715
716
D2
711
712
D1
A
B2'
B1
714
713
B3
6
71
72
H1
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717
X
Y
Z

FIG. 4

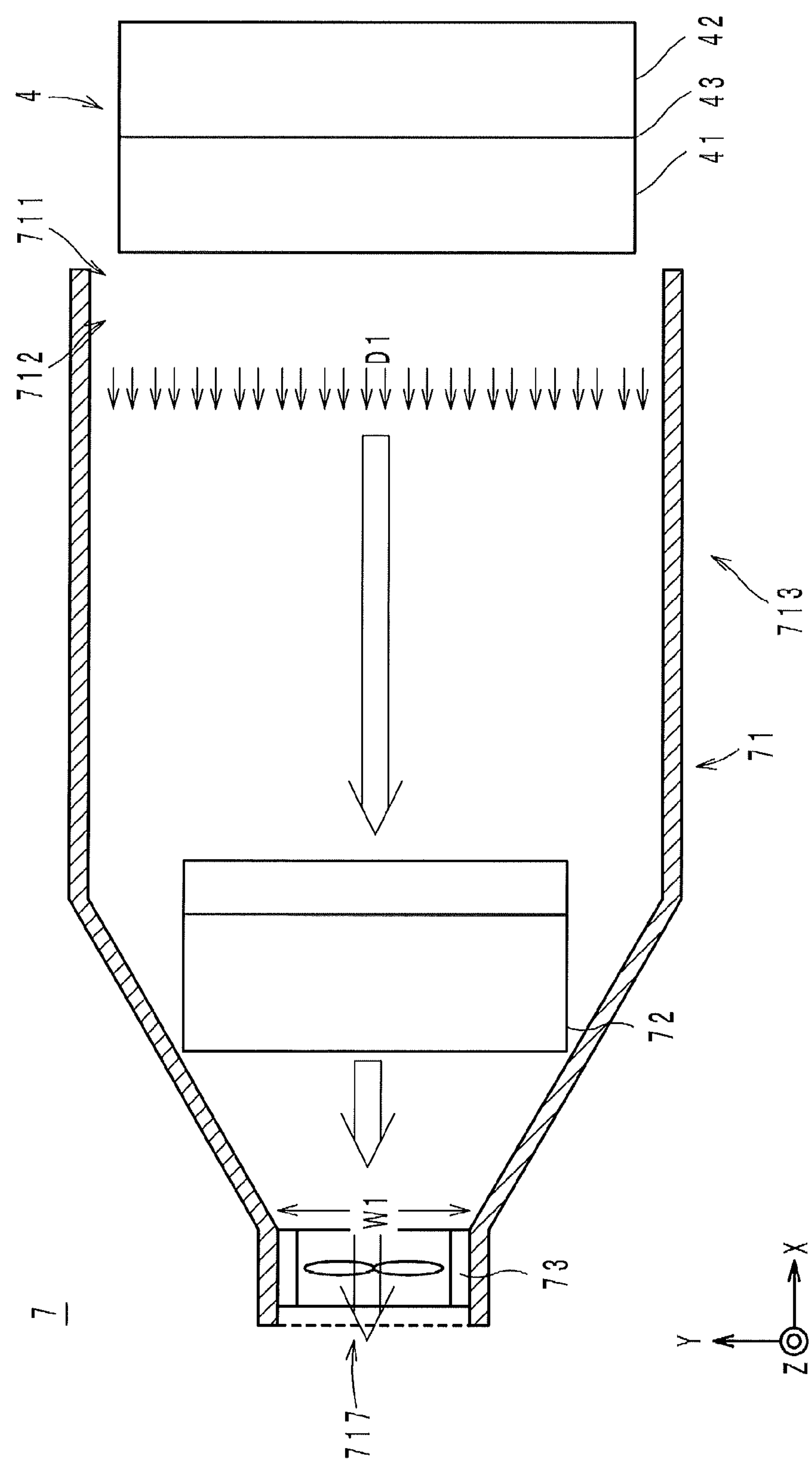

FIG. 5

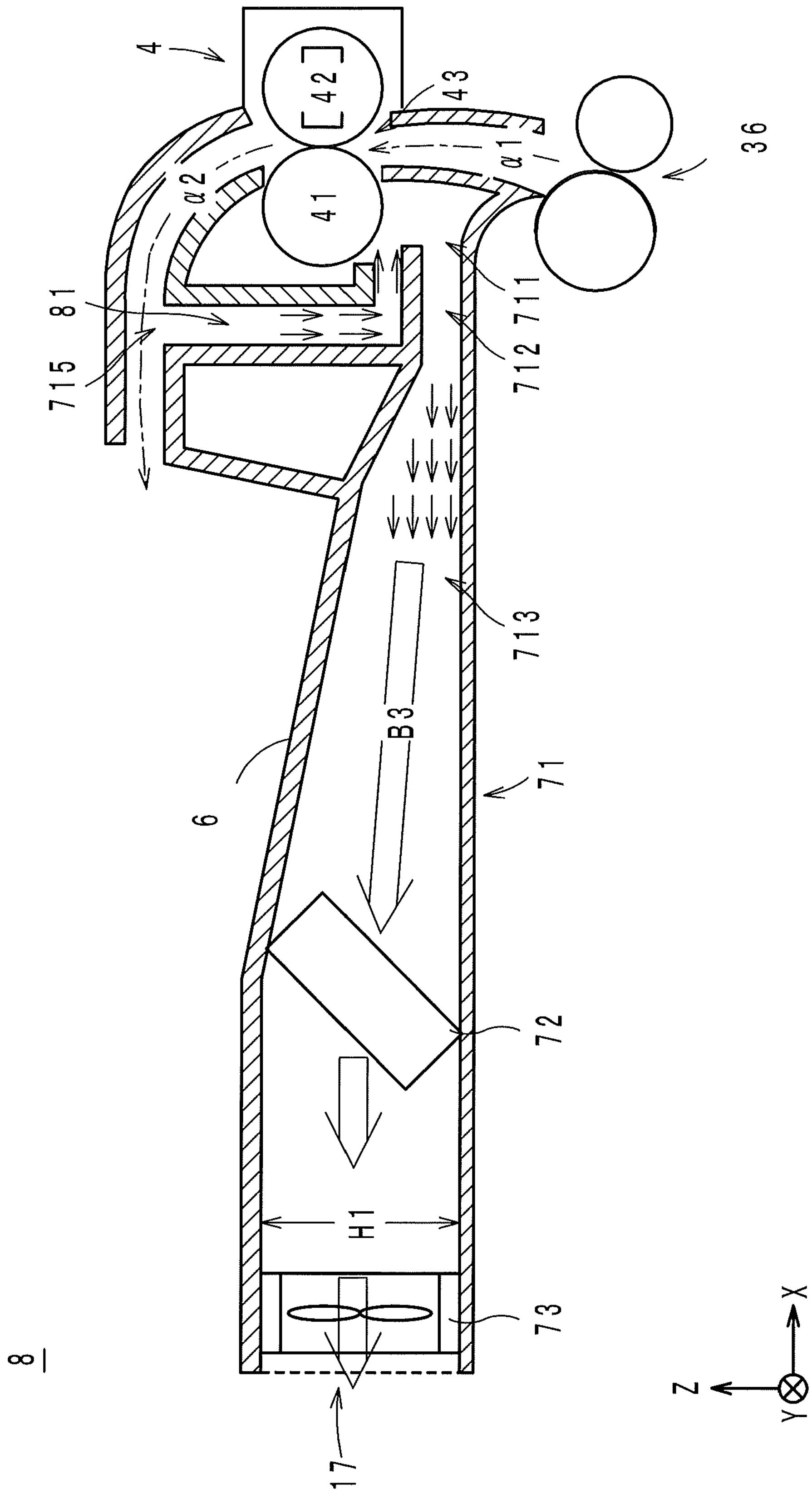

FIG. 6

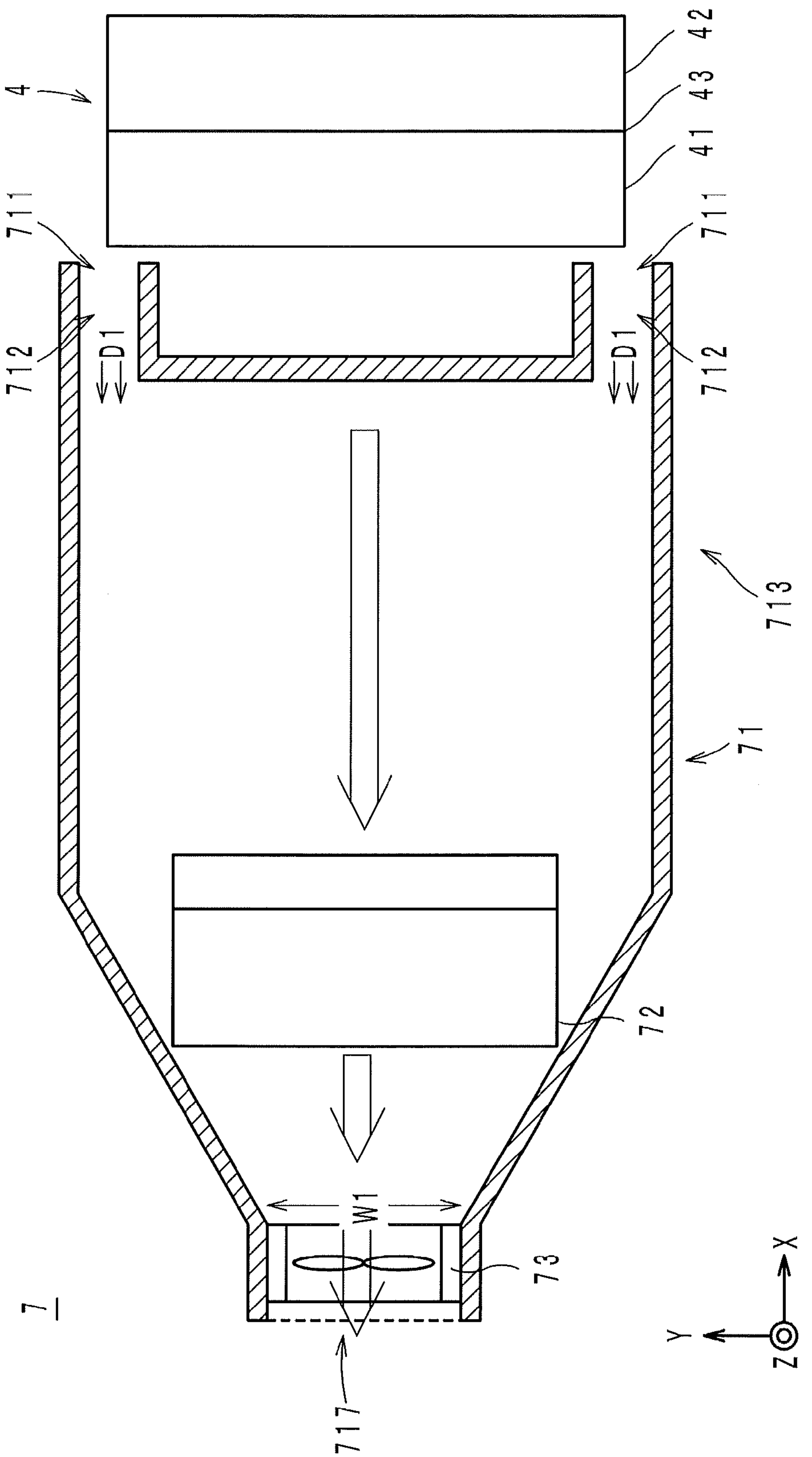

IMAGE FORMING APPARATUS

This application is based on Japanese Patent Application No. 2013-102815 filed on May 15, 2013, the content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus including a duct that traps ultrafine particles (UFPs) contained in the air surrounding a fusing unit while discharging the air to the outside of the apparatus.

2. Description of Related Art

Some conventional image forming apparatuses of this type include devices for removing ultrafine particles, as described in, for example, Japanese Patent Laid-Open Publication No. 2012-47790. Such an ultrafine particle removal device includes a duct and a suction fan for removing ultrafine particles, which are mainly derived from silicone rubber used as an elastic member of a fusing device. The duct has first and second terminus portions in which first and second openings are formed so as to face opposite ends, respectively, of a fusing roller in an axial direction. Moreover, the first terminus portion has a first suction port provided in the surface that is opposed to the first opening. Similarly, the second terminus portion is provided with a second suction port.

However, it is expected that the image forming apparatus will be required to further suppress the amount of UFP emission in the future.

SUMMARY OF THE INVENTION

An image forming apparatus according to a first aspect of the present invention includes an image forming unit for feeding a sheet after forming a toner image on the sheet, a fusing unit including a first rotor provided with a heat-generating unit and an elastic layer, as well as a second rotor provided in direct contact with the first rotor to create a nip, the fusing unit fixing a toner image on a sheet fed by the image forming unit and introduced into the nip, a duct for allowing an inlet and an exhaust outlet to communicate with each other, the inlet being adapted to allow a current of air derived from the fusing unit to flow in, the exhaust outlet facing toward the outside of the apparatus, and a blowing unit for causing a current of air toward the exhaust outlet within the duct. The duct includes an introduction channel for guiding and jetting out air taken in from the inlet, a main channel for guiding the air jetted out of the introduction channel to the exhaust outlet, and a cul-de-sac provided in communication with the main channel at one end and closed at the other end.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram illustrating the general configuration of an image forming apparatus;

FIG. **2** is a cross-sectional view illustrating in detail the configurations of first and second rotors included in a fusing unit shown in FIG. **1**;

FIG. **3** is a diagram illustrating in detail the configuration of an exhaust system shown in FIG. **1**;

FIG. **4** is a horizontal cross-sectional view of a main channel shown in FIG. **3**;

FIG. **5** is a diagram illustrating the configuration of an exhaust system according to a comparative example; and

FIG. **6** is a horizontal cross-sectional view illustrating another configuration example of the main channel shown in FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment

Hereinafter, an image forming apparatus according to an embodiment will be described in detail with reference to the drawings.

Preliminary Notes

First, the X-, Y-, and Z-axes in the drawings will be described. The X-, Y-, and Z-axes are perpendicular to one another. In addition, the X-, Y-, and Z-axes represent the right-left, front-back, and top-bottom directions, respectively, of the image forming apparatus **1**. Moreover, the direction of the Y-axis is the direction in which the image forming apparatus **1** is viewed from the front. Further, the opposite direction to the Z-axis is the direction in which the image forming apparatus **1** is viewed from the top.

Furthermore, the lowercase alphabet letters a, b, c, and d added to the ends of reference numerals are suffixes representing yellow (Y), magenta (M), cyan (C), and black (Bk), respectively. For example, a photoreceptor drum **32***a* is intended to mean a photoreceptor drum for yellow.

Configuration and Operation of Image Forming Apparatus

In FIG. **1**, the image forming apparatus **1** is, for example, an electrophotographic multifunction peripheral (MFP), copier, printer, or facsimile. Moreover, the image forming apparatus **1** employs, for example, a tandem configuration to print full-color images onto sheets (e.g., paper or OHP films). The image forming apparatus thus configured generally includes a feeding device **2**, an image forming unit **3**, and a fusing unit **4**.

The feeding device **2** has a plurality of sheets S mounted as a sheet stack. The feeding device **2** picks up the sheets S one by one from the sheet stack, and feeds them into a transportation path indicated by arrow α of a long dashed short dashed line (referred to below as a transportation path α).

In the image forming unit **3**, charging units **31***a* to **31***d* uniformly charge the circumferential surfaces of photoreceptor drums **32***a* to **32***d*, which are rotating. The charged surfaces of the photoreceptor drums **32***a* to **32***d* are irradiated with optical beams Ba to Bd from an exposing device **33**, so that electrostatic latent images in Y, M, C, and Bk are formed. Developing units **34***a* to **34***d* supply toner to the photoreceptor drums **32***a* to **32***d* supporting the respective electrostatic latent images in their corresponding colors, so that toner images in Y, M, C, and Bk are formed. The toner images on the photoreceptor drums **32***a* to **32***d* are sequentially transferred to the same area on an intermediate transfer belt **35**, which is rotating in the direction of arrow β (primary transfer). As a result, a full-color composite toner image is formed on the intermediate transfer belt **35**. The composite toner image is carried on the intermediate transfer belt **35** toward a secondary transfer area **36**.

Furthermore, a sheet S fed from the feeding device **2** is transported through the transportation path α until it hits a timing roller pair **37**, which is at rest without rotating. Thereafter, the timing roller pair **37** starts rotating so as to be synchronized with the timing of transfer in the secondary transfer area **36**, thereby feeding the sheet S at a temporary stop toward the secondary transfer area **36**.

In the secondary transfer area **36**, the composite toner image on the intermediate transfer belt **35** is transferred to the sheet S fed from the timing roller pair **37** (secondary transfer). The sheet S subjected to secondary transfer is fed downstream in the transportation path α as an unfinished sheet S, which is to be subjected to a fixing process.

The fusing unit **4** is of, for example, a heat roller fixing type, and includes a first rotor **41** and a second rotor **42**. The rotors **41** and **42** are in direct contact with each other to create a fixing nip **43**. The unfinished sheet S is introduced into the fixing nip **43**. The fusing unit **4** heats the unfinished sheet S passing through the nip **43**, by the rotor **41** while pressing the sheet S by the rotor **42**. As a result, the composite toner image on the unfinished sheet S is fixed completely. The sheet S subjected to the fixing process is fed from the nip **43**, further downstream in the transportation path α, to be ejected into a tray **6**.

Configuration Details of Fusing Unit

The first rotor **41** is a roller having a diameter of 24.8 millimeters [mm] and including an iron core **411**, a heater lamp **412**, a silicone rubber layer **413**, and a heat-resistant release layer **414**, as illustrated in FIG. **2**.

The heater lamp **412** is an example of a heat-generating unit, and is inserted into the core **411**, which is in the form of a cylinder. The silicone rubber layer **413** coats the circumferential surface of the core **411** to a thickness of 0.6 mm. The heat-resistant release layer **414** is perfluoroalkoxy alkane (PFA) tubing (fluororesin tubing) which coats the surface of the silicone rubber layer **413** to a thickness of 40 micrometers [μm]. The heat-resistant release layer **414** is provided in order to prevent toner adhesion. Here, the silicone rubber layer **413** is exposed from opposite ends of the first rotor **41** for convenience of processing.

The second rotor **42** is a roller having a diameter of 30.0 mm and including a STKM steel pipe **421** (where "STKM" indicates that the pipe is in conformity with the tubing specifications for machine structural purposes according to the Japanese Industrial Standard), a silicone rubber layer **422**, a silicone sponge layer **423**, and a heat-resistant release layer **424**.

The silicone rubber layer **422** coats the circumferential surface of the steel pipe **421**. The silicone sponge layer **423** coats the surface of the silicone rubber layer **422**. These two layers **422** and **423** are used as heat-resistant elastic layers. The heat-resistant release layer **424** is PFA tubing, which coats the surface of the silicone sponge layer **423**. Here, the silicone rubber layer **422** and the silicone sponge layer **423** are exposed from opposite ends of the second rotor **42**.

The rotor **42** is brought into direct contact with the rotor **41** under a pressure of about 215 newtons [N], thereby creating the fixing nip **43** measuring about 7 mm in the direction in which the sheet S passes therethrough (indicated by arrow γ).

In the fusing unit **4** thus configured, the silicone rubber layer **413** included in the first rotor **41** is heated by the heater lamp **412**. As a result of the heating, low-molecular siloxane is diffused from the silicone rubber layer **413** into the air in the form of UFPs. Similarly, UFPs might be diffused into the air also from the two layers **422** and **423** included in the second rotor **42**. In addition, UFPs might be also derived from the toner on the sheet S being heated by the fusing unit **4**

Configuration of Exhaust System

FIG. **1** will be referenced again. The image forming apparatus **1** includes an exhaust system **7** for mainly trapping UFPs. The exhaust system **7** includes a duct **71**, a filter **72**, and a blowing unit **73**, as shown in FIG. **3**. The duct **71** is made of a metallic material, such as stainless steel, which, for example, is not surface-treated, and the duct **71** generally includes a first inlet **711**, a first introduction channel **712**, a main channel **713**, a cul-de-sac **714**, a second inlet **715**, a second introduction channel **716**, and an exhaust outlet **717**.

An unfinished sheet is transported through a transportation path α**1** located upstream from the fusing unit **4**. The transportation path α**1** extends upward from the secondary transfer area **36** to a point immediately in front of the entry of the nip **43** created by the rotors **41** and **42**.

In the duct **71**, when viewed in a front view, the inlet **711** is provided so as to face to the right in a position obliquely below and to the left of the rotors **41** and **42** and the nip **43**. Further, the inlet **711** is positioned so as to face at least both ends of the rotor **41**, which extends in the front-back direction, as shown in FIG. **4**. In the present embodiment, the inlet **711** is an opening in the form of a slit that stretches over a length from one end of the rotor **41** to the other end. From the inlet **711** provided in such a position, air containing UFPs derived from the fusing unit **4** flows into the duct **71** when the blowing unit **73** to be described later is driven.

The introduction channel **712** extends from the inlet **711** leftward. Air flowing through the inlet **711** is guided leftward in the introduction channel **712**. The guided air is jetted out from the left end of the introduction channel **712** into the main channel **713**. The direction of air jetted out of the introduction channel **712** (i.e., a jet flow) will be referred to below as a first jetflow direction D**1**.

Furthermore, in the present embodiment, the introduction channel **712** has an approximately constant cross-sectional area S**1** (e.g., 1822 mm^2) across its dimension from the right end to the left end. Moreover, the average velocity V**1** of an air flow in the introduction channel **712** is 1.42 meters per second [m/s].

The introduction channel **712** communicates with the main channel **713** at the left end. The main channel **713** extends in the right-left direction from the left end of the introduction channel **712** to the left-side surface of the image forming apparatus **1**. The main channel **713**, when viewed in a front view, gradually increases in its height from the right end to a point from which an approximately constant height H**1** is kept toward the left end. Here, the height H**1** is designed in accordance with a dimension of the blowing unit **73** in the top-bottom direction.

FIG. **4** will now be referenced. FIG. **4** is a horizontal cross-section of the main channel **713** taken parallel to the XY plane and viewed from the positive side of the Z-axis. The main channel **713** is designed so as to be approximately constant in width from the right end to a point from which the width gradually decreases toward the left end. Moreover, the width W**1** of the main channel **713** at the left end is designed in accordance with a dimension of the blowing unit **73** in the front-back direction.

FIG. **3** will be referenced again. The main channel **713** as described above receives air jetted out of the introduction channel **712**. Moreover, the main channel **713** also receives air jetted out of the introduction channel **716** to be described later. The received air is guided leftward through the main channel **713**.

Furthermore, in the present embodiment, the main channel **713** has a cross-sectional area S**2** (e.g., 15,951 mm^2) on the immediately upstream side relative to the filter **72**. Here, this cross-section is parallel to the YZ plane. Moreover, the average velocity V**2** of an air flow in the cross-section is 0.23 m/s.

The cul-de-sac **714** is positioned above the right end of the main channel **713** (i.e., above the upstream end). The cul-de-sac **714** is open at one end so as to communicate with the main channel **713**. The cul-de-sac **714** extends from that end in a direction approximately vertical to the jetflow direction D**1**. Moreover, the cul-de-sac **714** is closed at the other end (i.e., the top end). The cul-de-sac **714** has walls both in the front-back direction and in the right-left direction. The space surrounded by the top end of the cul-de-sac **714** and the walls in the front-back direction and the right-left direction will be referred to below as a cul-de-sac space A.

Here, to enhance the capability of trapping UFPs, it is preferable that the cul-de-sac **714** be open at the bottom end and closed at the top end in a manner as described above.

Incidentally, the sheet S subjected to the fixing process is fed into a transportation path α**2**, which is located on the downstream side relative to the fusing unit **4**. The transportation path α**2** extends upward from the exit of the nip **43** to the left.

In the duct **71**, when viewed in a front view, the inlet **715** is provided in the bottom surface of the transportation path α**2** so as to face upward. From the viewpoint of suppressing the amount of UFPs released, the inlet **715** is preferably positioned in the transportation path α**2** close to the exit of the nip **43**, rather than distant therefrom toward the tray **6**. Moreover, the inlet **715**, when viewed in a top view, is positioned so as to face at least both ends of the rotor **41** extending in the front-back direction. The inlet **715** is an opening in the form of a slit having approximately the same dimension in the Y-axis direction as the inlet **711**. The inlet **715** provided in such a position receives air containing UFPs derived from the fusing unit **4**, when the blowing unit **73** is driven.

The introduction channel **716** extends from the inlet **715** downward. The air having entered the inlet **715** is guided through the introduction channel **716** downward. The guided air is jetted out of the bottom end of the introduction channel **716** toward the opening at the bottom end of the cul-de-sac **714**. The bottom end of the introduction channel **716**, i.e., an air vent, is positioned at the right wall of the cul-de-sac **714** near the bottom side. The direction of the air jetted out of the introduction channel **716** (i.e., jet flow) will be referred to below as a second jetflow direction D**2**.

Here, in the present embodiment, the introduction channel **716** has an approximately constant cross-sectional area S**3** (e.g., 592 mm^2) across its dimension from the top end to the bottom end. Moreover, the average velocity V**3** of an air flow in the introduction channel **716** is 1.68 m/s.

Further, the filter **72** is positioned on the upstream side relative to the blowing unit **73** in the main channel **713**. The filter **72** mainly traps UFPs from the air being guided through the main channel **713**.

Still further, the blowing unit **73** is typically a fan having a diameter of from 50 mm to 100 mm and positioned near the left end of the main channel **713** (i.e., immediately before the exhaust outlet **717**). The blowing unit **73** is rotated by a drive force from an unillustrated motor, thereby discharging air inside the main channel **713** to the outside of the image forming apparatus **1** through the exhaust outlet **717**.

Air Flow in Exhaust System

In the exhaust system **7**, to trap UFPs derived from the fusing unit **4**, the blowing unit **73** is driven during a fixing process, so that air in the duct **71** flows toward the exhaust outlet **715**. As a result, the air, which contains UFPs, is taken in from the first inlet **711**, and guided through the first introduction channel **712** to be jetted out into the main channel **713**. Moreover, air which contains UFPs is taken in also from the second inlet **715**, and guided through the second introduction channel **716** to be jetted out toward one end of the cul-de-sac space A (i.e., near the connection of the main channel **713** and the cul-de-sac **714**). The air jetted out of the introduction channels **712** and **716** flows into the main channel **713** and passes through the filter **72** and the blowing unit **73** to be discharged from the exhaust outlet **717** to the outside of the image forming apparatus **1**.

Actions and Main Effects of Exhaust System

In the exhaust system **7** thus configured, air jetted out of the introduction channel **712** (i.e., a jet flow) passes below the cul-de-sac space A, as indicated by arrow B**1** in FIG. **3**, to be guided to the downstream side in the main channel **713**. The air jet from the introduction channel **716** flows below the bottom of the cul-de-sac space A, as indicated by arrow B**2** in FIG. **3**, to be caused to merge with the air flowing in the main channel **713** and directed toward the downstream side.

Such an air flow entrains air existing in the cul-de-sac space A by virtue of the Coanda effect. As a result, relatively high negative pressure occurs around the air flow in the cul-de-sac space A. The negative pressure causes turbulence in the cul-de-sac space A. In FIG. **3**, the turbulence is indicated by vortexes. In general, UFPs around the walls of the cul-de-sac **714** are caused to adhere to the walls by virtue of, for example, electrostatic force, liquid bridge force, and Van del Waars force. Here, the process in which particles contained in a gas adhere to surrounding walls is described in, for example, "Deposition of Aerosol Particles on Solid Surfaces", Manabu Shimada and one other, Earozoru Kenkyu (Journal of Aerosol Research), Vol. 3, No. 4 (1988). In the exhaust system **7**, the adhesion of UFPs to the walls of the cul-de-sac **714** is further promoted by turbulent diffusion due to the turbulence caused in the cul-de-sac space A, in addition to the aforementioned forces, including electrostatic force. In this manner, the exhaust system **7** allows the cul-de-sac **714** to trap UFPs, so that the number of UFPs to be transported to the filter **72** provided on the downstream side can be reduced, and further, the amount of UFP emission to the outside of the image forming apparatus **1** can be reduced. Note that the UFPs that flow toward the filter **72** on the downstream side adhere in part to the inner wall of the main channel **713** to be trapped thereon.

To quantify the effect of the exhaust system **7**, the present inventors compared the image forming apparatus **1** including the exhaust system **7** (see FIG. **1**) with an image forming apparatus **9** including an exhaust system **8** according to a comparative example (see FIG. **5**) in terms of the amount of UFP emission. The exhaust system **8** according to the comparative example will be described first.

In FIG. **5**, the exhaust system **8** is different from the exhaust system **7** in that the cul-de-sac **714** is not provided, and an introduction path **81** is provided in place of the introduction channel **716**. There are no other differences between the exhaust systems **7** and **8**. Accordingly, in FIG. **5**, any elements corresponding to those shown in FIG. **3** are denoted by the same reference numerals, and any descriptions thereof will be omitted. Moreover, in the exhaust system **8** also, the main channel **713** has a cross-sectional area S**2** (e.g., 15,951 mm^2) on the immediately upstream side relative to the filter **72**, and the average velocity V**2** of an air flow in the cross-section is 0.23 m/s.

The introduction path **81** extends from the inlet **715** downward, and is bent rightward (i.e., toward the fusing unit **4**) at the bottom so as to form an approximately right angle.

Accordingly, the introduction path **81** ends below the first rotor **41**, and is open at the end. This opening communicates with the inlet **711** of the introduction channel **712**. Therefore, air having entered the introduction path **81** through the inlet **715** is guided first downward and then rightward to be jetted out of the opening of the introduction path **81**. The air jet is guided through the introduction channel **712** after merging with the air having entered through the inlet **711**.

The present inventors measured the number of UFPs discharged from each of the image forming apparatuses **1** and **9**. The UFPs were measured in accordance with a test method which met the requirements for acquisition of the Blue Angel Mark (BAM). Details of the measurements are as will be described below.

Each of the image forming apparatuses **1** and **9** was placed in a measurement room. The temperature inside the measurement room was approximately from 22° C. to 23° C., and the humidity was about 50%.

In the measurement room, each of the image forming apparatuses **1** and **9** was kept on standby for 60 minutes after power-on, and then continued to print for 10 minutes. Specifically, color printing patterns for use in the BAM test were printed on one side of A4 sheets.

A fast mobility particle sizer (FMPS) 3091 from Tokyo Dylec Corp. was used to measure the amount of UFP emission. The measurement results for the amount of UFP emission were 1.0×10^{11} counts per 10 minutes for the image forming apparatus **1**, and 2.0×10^{11} counts per 10 minutes for the image forming apparatus **9**. In this manner, there was confirmed to be a difference of two times in the amount of UFP emission between the presence and the absence of the cul-de-sac **714**.

Other Effects

Furthermore, it is preferable that the cul-de-sac **714** be connected with the main channel **713** on the bottom-end side and closed on the top-end side, as shown in FIG. **3**. The reason for this is that, because air containing UFPs is at a high temperature and therefore is prone to rise, adhesion of UFPs to the top end of the cul-de-sac **714** is facilitated by closing the cul-de-sac **714** on the top-end side. Thus, the capability of trapping UFPs can be enhanced.

In addition, the cul-de-sac **714** is preferably provided at the upstream end of the main channel **713**, as shown in FIG. **3**. Accordingly, in the main channel **713**, the average velocity of the air flowing below the cul-de-sac **714** (i.e., at the upstream end of the main channel **713**), as indicated by arrows B**1** and B**2**, is higher than that of the air flowing on the downstream side relative to the connection of the main channel **713** and the cul-de-sac **714**, as indicated by arrow B**3** in FIG. **3**. As a result, relatively more negative pressure occurs around the air flow in the cul-de-sac space A, so that UFPs can be trapped in the cul-de-sac **714** more efficiently.

Further, the cul-de-sac **714** preferably crosses the main channel **713** approximately at a right angle. The crossing approximately at a right angle causes the air flowing out of the introduction channel **712** in the jetflow direction D**1** to hit the downstream wall of the cul-de-sac **714** (in FIG. **3**, on the left side), which facilitates the occurrence of turbulence. Moreover, since the introduction channel **716** is provided along the upstream wall of the cul-de-sac **714**, the air flowing out of the introduction channel **716** in the second jetflow direction D**2** is caused to hit the cul-de-sac **714** in the lower portion of its downstream wall more readily, which facilitates the occurrence of turbulence. In this manner, the occurrence of turbulence in the cul-de-sac space A is facilitated, leading to an enhanced capability of trapping UFPs.

Still further, a set of an inlet and an introduction channel is preferably provided on each of the upstream (i.e., bottom) and downstream (i.e., top) sides relative to the nip **43** and the first rotor **41** in the transportation path α for the sheet S, as shown in FIG. **3**. As a result, more UFPs can be trapped, resulting in a further reduction in the amount of UFP emission.

Yet further, air is jetted out from the second introduction channel **716** preferably toward one end of the cul-de-sac **714**, as shown in FIG. **3**. More specifically, the air jet from the second introduction channel **716** basically travels through the opening of the cul-de-sac **714** to be caused to merge with an air jet from the first introduction channel **712** toward the main channel **713**. The merger facilitates the occurrence of turbulence at that end of the cul-de-sac **714**. Thus, UFPs can adhere to the wall of the cul-de-sac **714** more readily.

Supplementary

Furthermore, the downstream wall of the cul-de-sac **714** is slanted, rather than perpendicular (vertical) to the bottom of the duct **71**, such that the space defined by the wall increases toward the bottom, as shown in FIG. **3**, but this shape is not limiting, and the cul-de-sac **714** may have a duct-like shape that extends vertically.

In addition, the distance between the bottom end of the downstream wall of the cul-de-sac **714** and the bottom surface of the duct **71** is greater than the dimension (height) of the introduction channel **712** in the top-bottom direction, but it can be equal to the height of the introduction channel **712**.

Further, the inlet **711** has been described above as being a slit-like opening that runs from one end of the rotor **41** to the other end, as shown in FIG. **4**. However, this is not limiting, and two slit-like openings may be provided as inlets **711**, so as to face opposite ends, respectively, of the rotor **41** extending in the front-back direction, as shown in FIG. **6**. As with the inlets **711**, two slit-like openings may be provided as inlets **715**.

Although the present invention has been described in connection with the preferred embodiment above, it is to be noted that various changes and modifications are possible to those who are skilled in the art. Such changes and modifications are to be understood as being within the scope of the invention.

What is claimed is:

1. An image forming apparatus comprising:

an image forming unit for feeding a sheet after forming a toner image on the sheet;

a fusing unit including a first rotor provided with a heat-generating unit and an elastic layer, as well as a second rotor provided in direct contact with the first rotor to create a nip, the fusing unit fixing a toner image on a sheet fed by the image forming unit and introduced into the nip;

a duct for allowing a first inlet and an exhaust outlet to communicate with each other, the first inlet provided on an upstream side in a sheet transportation path relative to the nip and the first rotor and being adapted to allow a current of air derived from the fusing unit to flow in, the exhaust outlet facing toward the outside of the apparatus; and

a blowing unit comprising a fan, for causing a current of air toward the exhaust outlet within the duct, wherein,

the duct includes:

a first introduction channel for guiding air taken in from the first inlet and jetting out air taken in from the first inlet;

a main channel for guiding the air jetted out of the first introduction channel to the exhaust outlet; and a cul-de-sac provided in communication with the main channel at one end and closed at the other end;

a second inlet provided on a downstream side in the sheet transportation path relative to the nip and the first rotor; and

a second introduction channel for guiding air taken in from the second inlet and jetting out the air from between the one end and the other end of the cul-de-sac.

2. The image forming apparatus according to claim **1**, wherein the one end and the other end of the cul-de-sac are a bottom end and a top end, respectively.

3. The image forming apparatus according to claim **1**, wherein the cul-de-sac is provided at an upstream end of the main channel.

4. The image forming apparatus according to claim **1**, wherein the cul-de-sac crosses the main channel approximately at a right angle.

5. The image forming apparatus according to claim **1**, wherein the second introduction channel jets out air toward the one end of the cul-de-sac.

6. The image forming apparatus according to claim **1**, wherein a filter is provided in the main channel, the one end of the cul-de-sac that is in communication with the main channel is an opening of the cul-de-sac, and the opening is provided upstream of the filter.

7. The image forming apparatus according to claim **1**, wherein the one end of the cul-de-sac that is in communication with the main channel is an opening of the cul-de-sac, and the opening opens into the main channel at a right angle.

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